

# U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

**Scientific Name:**

Hylaeus mana

**Common Name:**

Hawaiian Yellow-faced bee

**Lead region:**

Region 1 (Pacific Region)

**Information current as of:**

06/19/2014

**Status/Action**

☐ Funding provided for a proposed rule. Assessment not updated.

☐ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

☐ New Candidate

☒ Continuing Candidate

☐ Candidate Removal

☐ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

☐ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

☐ Range is no longer a U.S. territory

☐ Insufficient information exists on biological vulnerability and threats to support listing

☐ Taxon mistakenly included in past notice of review

☐ Taxon does not meet the definition of "species"

☐ Taxon believed to be extinct

☐ Conservation efforts have removed or reduced threats

\_\_\_ More abundant than believed, diminished threats, or threats eliminated.

## **Petition Information**

\_\_\_ Non-Petitioned

X Petitioned - Date petition received: 03/23/2009

90-Day Positive:06/16/2010

12 Month Positive:09/06/2011

Did the Petition request a reclassification? **No**

### **For Petitioned Candidate species:**

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing?  
**Yes**

Explanation of why precluded:

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, the majority of our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements; meeting statutory deadlines for petition findings or listing determinations; emergency listing evaluations and determinations; and essential litigation-related administrative and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of Progress on Revising the Lists, in the current CNOR which can be viewed on our Internet website (<http://endangered.fws.gov/>).

## **Historical States/Territories/Countries of Occurrence:**

- **States/US Territories:** Hawaii
- **US Counties:** Honolulu, HI
- **Countries:** United States

## **Current States/Counties/Territories/Countries of Occurrence:**

- **States/US Territories:** Hawaii
- **US Counties:** Honolulu, HI
- **Countries:** United States

## **Land Ownership:**

*Hylaeus mana* is known from four populations on State land on the island of Oahu (Daly and Magnacca 2003, pp. 135-136; Magnacca and King 2013, pp. 18-19).

## **Lead Region Contact:**

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## **Biological Information**

### **Species Description:**

*Hylaeus mana* is similar in structure to other hymenopterans (bees, wasps, and ants) in that adults have three main body parts—a head, thorax, and abdomen. One pair of antennae arises from the front of the head, between the eyes. Two pairs of wings and three pairs of legs are attached to the thorax. The abdomen is composed of multiple segments (Borror et al. 1989, pp. 665-666).

The *Hylaeus* genus, which includes *H. mana*, are commonly known as yellow-faced bees or masked bees for their yellow-to-white facial markings. All of the *Hylaeus* species roughly resemble small wasps in appearance, due to their slender bodies and their seeming lack of setae (sensory hairs). However, *Hylaeus* bees have plumose (branched) hairs on the body that are longest on the sides of the thorax. To a discerning eye, it is these plumose setae that readily distinguish them from wasps (Michener 2000, p. 55).

This species is an extremely small, gracile (gracefully slender) black bee with yellow markings on the face. The smallest of all Hawaiian *Hylaeus* species, *H. mana* is a member of the Dumetorum species group. The face of the male is largely yellow below the antennae, extending dorsally in a narrowing stripe. The female's face has three yellow lines, one against each eye, and a transverse stripe at the apex of the clypeus (lower face region). The females other markings are the same as the males (Daly and Magnacca 2003, p. 135). *H. mana* can be distinguished from *H. mimicus* and *H. specularis*, species with overlapping ranges, by its extremely small size, the shape of the males genitalia, the females extensive facial marks, and a transverse rather than longitudinal clypeal marking (Daly and Magnacca 2003, p. 138).

### **Taxonomy:**

*Hylaeus mana* was first described by Daly and Magnacca (2003, pp. 135-136) from four specimens collected in 2002 on the leeward side of the Koolau Mountains on Oahu.

### **Habitat/Life History:**

The general life cycle of *Hylaeus mana* is typical of most solitary bees: after mating, females create a nest in which to lay eggs that will hatch and develop into larvae (immature stage); as larvae grow, they molt (shed their skin) through three successive stages (instars); when fully grown the larvae change into pupae (a resting form) in which they metamorphose and emerge as adults (Borror et al. 1989, p. 665).

Hawaiian *Hylaeus* species are grouped within two categories: ground-nesting species that require relatively dry conditions, and stem-nesting species that are often found within wetter areas (Zimmerman 1972, p. 533; Daly and Magnacca 2003, p. 11). *H. mana* is believed to be a stem-nesting species (Magnacca 2005g, p. 2; Magnacca and Danforth 2006, p. 403), and the species likely constructs nests opportunistically within existing burrows inside dead twigs or plant stems. This is unlike the nest construction of many other bee species, which are purposefully excavated or constructed underground. All *Hylaeus* spp., including the Hawaiian *Hylaeus* species, lack strong mandibles and other adaptations for digging and often use nest burrows abandoned by other insect species (Daly and Magnacca 2003, p. 9). *H. mana* females lay eggs in

brood cells she constructs in the nest and lines with a self-secreted, cellophane-like material. Prior to sealing the nest, the female provides her young with a mass of semiliquid nectar and pollen left alongside her eggs. Upon hatching, the grub-like larvae eat the provisions left for them, grow and molt through three instar stages, pupate, and eventually emerge as adults (Michener 2000, p. 24).

The exact diet of the larval stage of *H. mana* is unknown, although the larvae are presumed to feed on stores of pollen and nectar collected and deposited in the nest by the adult female (Daly and Magnacca 2003, p. 9). Likewise, the exact nesting habits of *H. mana* are not known, but the species is thought to nest within the stems of mesic shrub species (Magnacca and Danforth 2006, p. 403). Adult specimens of *H. mana* have been collected while they visited flowers of *Psychotria* spp. and *Santalum freycinetianum* var. *freycinetianum* (iliahī, sandalwood), a native Hawaiian plant found only on Oahu and Molokai (Wagner et al. 1999, p. 1,221; Magnacca and King 2013, pp. 18-19). It is likely *H. mana* visits several other native plant species, including *Acacia koa* (koa), *Metrosideros polymorpha* (ohia), *Styphelia tameiameia* (pukiawe), *Scaevola* spp. (naupaka), and *Chamaesyce* spp. (akoko) (Magnacca 2005g, p. 2). *H. mana*, like most *Hylaeus* species, lack an external structure for carrying pollen, called a scopa, and instead internally transport collected pollen, often mixed with nectar, within their crop (stomach).

Recent studies of visitation records of Hawaiian *Hylaeus* bees, to native flowers (Daly and Magnacca 2003, p. 11) and pollination studies of native plants (Sakai et al. 1995, pp. 2,524-2,528; Cox and Elmqvist 2000, p. 1,238; Sahli et al. 2008, p. 1) have demonstrated Hawaiian *Hylaeus* species almost exclusively visit native plants to collect nectar and pollen, pollinating those plants in the process. *Hylaeus* bees are very rarely found visiting nonnative plants for nectar and pollen (Magnacca 2007a, pp. 186, 188) and are almost completely absent from habitats dominated by nonnative plant species (Daly and Magnacca 2003, p. 11). Sahli et al. (2008, p. 1) quantified pollinator visitation rates to all of the flowering plant species in communities on a Hawaiian lava flow dating from 1855 to understand how pollination webs and the integration of native and nonnative species changes with elevation. In that study, eight flowering plants were observed at six sites, which ranged in elevation from approximately 2,900 to 7,900 feet (ft) (approximately 880 to 2,400 meters (m)). The study also found the proportion of native pollinators changed along the elevation gradient; at least 40 to 50 percent of visits were from nonnative pollinators at low elevation, as opposed to 4 to 20 percent of visits by nonnative pollinators at mid to high elevations. *Hylaeus* bees were less abundant at lower elevations, and there were lower visitation rates of any pollinators to native plants at lower elevations, which suggest *Hylaeus* may not be easily replaceable by nonnative pollinators (Sahli et al. 2008, p. 1).

## Historical Range/Distribution:

*Hylaeus mana* was first discovered in lowland mesic forest located along the Manana Trail in the Koolau Mountains on Oahu, at an elevation of about 1,400 ft (430 m). Few *Hylaeus* bees have been found in this type of *Acacia koa*-dominated, lowland mesic forest on Oahu (Daly and Magnacca 2003, p. 138). This type of forest is increasingly rare and patchily distributed on Oahu (Smith 1985, pp. 227-233; Juvik and Juvik 1998, p. 124; Wagner et al. 1999, pp. 66-67, 75).

The Manana Trail is part of the Na Ala Hele Hawaii Statewide Trail and Access System (Hawaii Department of Land and Natural Resources (HDLNR) 2007), and is located within the States Ewa Forest Reserve (FR). Six miles in length, the beginning of the Manana Trail is dominated by nonnative plant species, but leads into an area of native forest where *Acacia koa*, *Metrosideros polymorpha*, and *Scaevola* spp. are common (DLNR 2011).

## Current Range Distribution:

In addition to the original population site at Manana Trail, three additional *Hylaeus mana* population sites were discovered on Oahu in 2012, including a new observation of the species at the Manana Trail site (Magnacca and King 2013, pp. 17-18). Like the original population site, the three new population sites occur within the leeward Koolau Mountains at an elevation of approximately 1,400 ft (427 m). All sites occur in a

narrow range of lowland mesic forest habitat bordered by nonnative plant habitat at lower elevations and wetter forest habitat at higher elevation (Magnacca and King 2013, pp. 17-18). Most of the 2012 observations of *H. mana* occurred on *Santalum freycinetianum* var. *freycinetianum*, (including its original discovery at Manana Trail), which suggests that *H. mana* may be closely associated with this plant species (Magnacca and King 2013, p. 18).

Additional surveys in potentially suitable habitat may reveal additional populations elsewhere on Oahu (Magnacca 2007a, p. 184; Magnacca and King 2013, pp. 17-18). However, the extreme rarity of this species, its absence from many survey sites, the fact it was not discovered until very recently, and the limited range of its possible host plant, *Santalum freycinetianum* var. *freycinetianum*, suggests few populations remain (Magnacca 2005g, p. 2; Magnacca and King 2013, pp. 17-18).

## Population Estimates/Status:

*Hylaeus mana* is currently known from four population sites within lowland mesic forest habitat (Magnacca 2005a, p. 2; Magnacca and King 2013, pp. 17-18) on the island of Oahu. The size of these populations is unknown, although no more than four individuals have ever been observed at any site (Magnacca and King 2013, pp. 17-18). Table 1, below, summarizes information about the current population sites for this species.

Table 1. Occupied population sites and habitat conservation status of *Hylaeus mana* on the island of Oahu.

	Population site	Island	Land Owner	Last Year Observed (or surveyed)	Approx. Size (in acres)	Habitat Conservation Status & Threats
1	Manana Trail (Ewa Forest Reserve)	Oahu	State	2012	Unknown	Some conservation
2	Aiea Ridge Trail	Oahu	State	2012	Unknown	Some conservation
3	Moanalua (Tripler) Ridge Trail	Oahu	State	2012	Unknown	Some conservation
4	Mauumae Ridge Trail	Oahu	State	2012	Unknown	Some conservation

## Threats

### A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Degradation and loss of lowland habitat is the primary threat to *Hylaeus mana* (Cuddihy and Stone 1990, pp. 60-61; Daly and Magnacca 2003, pp. 55, 173; Magnacca 2007a, p. 188). Lowland forest habitats have been severely altered and degraded, partly because of past and present land management practices, including agriculture, grazing, and urban development; the deliberate and accidental introductions of nonnative animals and plants; and recreational activities. In addition, fire is a potential threat to the habitat of *H. mana* in some locations.

#### Habitat Destruction and Modification by Urbanization and Land Use Conversion

Destruction and modification of *Hylaeus* bee habitat by urbanization and land use conversion leads to the direct loss and fragmentation of foraging and nesting habitat of *H. mana*. In particular, because native host plant species are known to be essential to *H. mana* for foraging of nectar and pollen, any further loss of this habitat may endanger its long-term chances for conservation and recovery. Additionally, conversion and modification of suitable habitat for *H. mana* is also likely to further exacerbate the introduction and spread of

nonnative plants into and within these areas (see Habitat Destruction and Modification by Nonnative Plants section below).

### Lowland Mesic Habitat

Hawaii's lowland mesic forest habitat was once abundant and considered the most diverse (in terms of number of species) of all Hawaiian forest types (Rock 1913, p. 9). Lowland mesic forest habitat is now very rare, and has been converted to pasture, military use, agricultural use, or lost to urbanization. Development and land use conversion is ongoing (Cuddihy and Stone 1990, p. 61; Magnacca 2007, p. 187; Wagner et al. 1999, p. 75). Fire has also negatively impacted this habitat type and remains a significant threat (see Habitat Destruction and Modification by Fire section below).

*H. mana* is known from four population sites in lowland mesic forest habitat on the island of Oahu. Because we lack information on the historical range of *H. mana* (the species was only discovered relatively recently), we are unable to determine the extent of habitat loss this species has experienced. However, because the extent and the quality of lowland mesic forest has been reduced throughout the Hawaiian Islands, it is reasonable to conclude *H. mana* now has less habitat because of urbanization and land use conversion.

In summary, destruction and modification by urbanization and land use conversion of the lowland habitat of *H. mana* is continuing and is expected to continue reducing and fragmenting the remaining habitat available to this species in the future, endangering the species long-term chances for conservation and recovery. Because of the decreased amount of suitable native lowland habitat remaining in the Hawaiian Islands and the continued conversion of these native habitats by development, road building, or agriculture, we conclude the ongoing habitat loss and land modification is a significant ongoing threat to *H. mana*.

### Habitat Destruction and Modification by Nonnative Plants

Native vegetation on all of the main Hawaiian Islands has undergone extreme alteration because of past and present land management practices, including ranching, agricultural development, and the deliberate introduction of nonnative plants and animals (Cuddihy and Stone 1990, pp. 27, 58). The original native flora of Hawaii (species that were present before humans arrived) consisted of about 1,000 taxa, 89 percent of which were endemic (species that occur only in the Hawaiian Islands). Over 800 plant taxa have been introduced from elsewhere, and nearly 100 of these have become pests (e.g., injurious plants) in Hawaii (Smith 1985, p. 180; Cuddihy and Stone 1990, p. 73; Gagne and Cuddihy 1999, p. 45). Some of these plants were brought to Hawaii by various groups of people, including the Polynesians, for food or cultural reasons. Beginning in the early 1900s, plantation owners (and the territorial government of Hawaii), alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral and domestic animals, introduced nonnative trees for reforestation and continued the practice through the late 1930s (The Nature Conservancy (TNC) 2003, p. 19). Ranchers intentionally introduced pasture grasses and other nonnative plants for agriculture, and sometimes inadvertently introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Scott et al. 1986, pp. 361-363; Cuddihy and Stone 1990, p. 73).

Nonnative plants adversely impact native Hawaiian habitat, including that of *H. mana*, by modifying the availability of light, altering soil-water regimes, modifying nutrient cycling, and altering fire characteristics of native plant communities. A major concern is that successive fires burn farther and farther into native habitat, destroy native plants, and remove habitat for native species by altering microclimatic conditions to favor nonnative species, ultimately converting native dominated plant communities to nonnative plant communities (Smith 1985, pp. 180-181; Cuddihy and Stone 1990, p. 74; DAntonio and Vitousek 1992, p. 73; Vitousek et al. 1997, p. 6). Nonnative plants directly and indirectly affect *H. mana* by modifying or destroying its lowland forest habitat and reducing food sources.

The spread of nonnative plant species is one of the primary causes of decline of *H. mana*, and a current threat

to its existing population because the species depends closely on native vegetation for nectar and pollen. *Hylaeus* bees in general are almost entirely absent from habitat dominated by invasive, nonnative vegetation (Sakai et al. 2002, pp. 276, 291; Daly and Magnacca 2003, p. 11; Liebherr 2005, p. 186). The native flora within most of lowland habitat in the Hawaiian Islands is being replaced by aggressive, nonnative plant species (Cuddihy and Stone 1990, pp. 73-74; Wagner et al. 1999, p. 52). Many native plant species communities that have been replaced by often monotypic communities of nonnative plants were once foraging resources for numerous species of *Hylaeus* bees including *H. mana* (Cox and Elmqvist 2000, p. 1,238; Daly and Magnacca 2003, p. 11; USFWS 1999, pp. 145, 163, 171, 180; USFWS 2008b, pp. 7, 9).

Many of the native plants that currently serve as foraging resources for *H. mana* are declining due to a lack of pollinators and competition with nonnative plants (Daly and Magnacca 2003, p. 11; USFWS 2008b, pp. 7, 9; Smith 1985, pp. 180-181; Cuddihy and Stone, 1990, p. 74; DAntonio and Vitousek 1992, p. 73; Vitousek et al. 1997, p. 6), and are found only in very small populations (USFWS 1999, pp. 145, 163, 171, 180; Cox and Elmqvist 2000, p. 1,238). As noted in the Life History section, above, *Hylaeus* species almost exclusively visit native plants to collect nectar and pollen (Daly and Magnacca 2003, p. 11), pollinating those plants in the process (Sakai et al. 1995, pp. 2,524-2,528; Cox and Elmqvist 2000, p. 1,238; Sahli et al. 2008, p. 1). *Hylaeus* bees are very rarely found visiting nonnative plants for nectar and pollen (Magnacca 2007a, pp. 186, 188). Unpublished data on *Hylaeus* spp. pollen use (Magnacca, in litt. 2011, p. 65) suggest only approximately three percent of pollen collected by yellow-faced bees in general is from nonnative plant sources.

In summary, the spread of nonnative plants throughout the lowland habitat of *H. mana* represents a serious and ongoing threat to this species. Many of the native plant species being replaced by invasive, nonnative plants provide foraging resources (e.g. pollen, nectar) for *Hylaeus* bees, including *H. mana*. The best available information indicates *H. mana* does not characteristically forage on nonnative plants (Daly and Magnacca 2003, p. 13). Only 14 of 820 recent (1998 to 2010) *Hylaeus* spp. observations were on flowers of nonnative plant species; however, none of those observations involved *H. mana*. Therefore, we conclude that the ongoing spread of nonnative plants into the habitat of *H. mana* remains a significant threat due to the manner in which nonnative plants alter and fragment habitat, increase the likelihood of fire, and attract nonnative insect species. This threat further endangers the species long-term chances for conservation and recovery.

#### Habitat Destruction and Modification by Nonnative Ungulates

The presence of nonnative mammals, such as feral pigs (*Sus scrofa*), cattle (*Bos taurus*), goats (*Capra hircus*), and axis deer (*Axis axis*), is considered one of the primary factors underlying the alteration and degradation of native vegetation and habitat in the Hawaiian Islands (Stone 1985, pp. 262-263; Cuddihy and Stone 1990, pp. 60-66; 73 FR 73801). Beyond the direct effects of trampling and consuming native plants, nonnative ungulates contribute significantly to increased erosion, and their behavior (i.e., rooting and moving across large areas) facilitates the spread and establishment of competing, invasive, nonnative plant species (Cuddihy and Stone 1990, p. 65). Feral pigs occur on all of the main Hawaiian Islands except Kahoolawe and Lanai (Hawaii Ecosystems at Risk (HEAR) 2005; Kessler 2011, pers. comm.); and goats are found on all of the main Hawaiian Islands except Lanai (HEAR 2005).

The State of Hawaii provides game mammal (e.g., feral pigs, goats, and deer) hunting opportunities on State-designated public hunting areas on the islands of Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu (Hawaii Administrative Rules § 13-123-1413-123-20; HDLNR 1999). The States management objectives for game animals ranges from maximizing public hunting opportunities (e.g., sustained yield) in some areas to removal by State staff, or their designees, in other areas (Hawaii Administrative Rules § 13-123). The one known population for *H. mana* is adjacent to areas where terrestrial habitat may be manipulated for game enhancement and where game populations are maintained at certain levels for public hunting (Hawaii Administrative Rules § 13-123). Public hunting areas are predominantly not fenced, and game mammals have unrestricted access to most areas across the landscape, regardless of underlying land use designation.

While fences are sometimes built to provide protection from game mammals to the natural resources within the fenced area, the current number and locations of fences are not adequate to prevent habitat destruction and degradation of the lowland mesic habitat of *H. mana*.

In summary, feral pigs and goats continue to alter and degrade native vegetation within *H. mana* habitat in the Hawaiian Islands. We believe these ungulates represent a significant and ongoing threat to the continued existence of *H. mana*, endangering the species long-term chances for conservation and recovery. Ungulates directly trample and consume native plants, including plants used for foraging by *H. mana*. The best available information indicates that *H. mana* does not use nonnative plants for foraging (Daly and Magnacca 2003, p. 13). While some specific areas throughout the State, including the known *H. mana* habitat site, are managed to exclude the presence of or control ungulates, we are unaware of any plans to entirely eradicate or eliminate ungulates from the Hawaiian Islands. In addition, public hunting areas maintain populations of nonnative ungulates and often do not provide adequate fencing to prevent nonnative ungulates from negatively impacting the habitat of *H. mana*. Therefore, the ongoing alteration and degradation of many of the native lowland habitats where *H. mana* occurs by ungulates is expected to further impact this species foraging and nesting habitat through the direct consumption and trampling of native plants, introduction and spread of nonnative plants, and increased erosion.

#### Habitat Destruction and Modification by Fire

Fire is a relatively new, human-exacerbated threat to native species and natural vegetation in Hawaii. The historical fire regime in Hawaii was characterized by infrequent, low severity fires, as few natural ignition sources existed (Cuddihy and Stone 1990, p. 91; Smith and Tunison 1992, pp. 395-397). Natural fuel beds were often discontinuous, with moderate to high rainfall in many areas on most islands. Fires inadvertently or intentionally ignited by the original Polynesians in Hawaii probably contributed to the initial decline of native vegetation in the drier plains and foothills. These early settlers practiced slash-and-burn agriculture that created open lowland areas suitable for the later colonization of nonnative, fire-adapted grasses (Kirch 1982, pp. 5-6, 8; Cuddihy and Stone 1990, pp. 30-31). Beginning in the late 18th century, Europeans and Americans introduced plants and animals that further degraded native Hawaiian ecosystems. Pasture areas and ranching, in particular, created highly fire-prone areas of nonnative grasses and shrubs (DAntonio and Vitousek 1992, p. 67). Fires of all intensities, seasons, and sources are destructive to native Hawaiian ecosystems (Brown and Smith 2000, p. 172), and a single grass-fueled fire can kill most native trees and shrubs in the burned area (DAntonio and Vitousek 1992, p. 74). Although Vogl (1969) (in Cuddihy and Stone 1990, p. 91) suggests naturally occurring fires, primarily from lightning strikes, have been important in the development of the original Hawaiian flora, and many Hawaiian plants might be fire-adapted, Mueller-Dombois (1981) (in Cuddihy and Stone 1990, p. 91) points out most natural vegetation types of Hawaii would not carry fire before the introduction of nonnative grasses. Smith and Tunison (in Cuddihy and Stone 1990, p. 91) state that native plant fuels typically have low flammability.

Fire represents a threat to *H. mana* in lowland mesic habitat. Fire threatens *H. mana* by destroying the native plant species and communities on which the species depends and opening up habitat for increased invasion by nonnative plants. Fire can destroy dormant seeds of native plants as well as the plants themselves. Successive fires that burn farther and farther into native habitat destroy native plants and remove habitat for native plant and animal species by altering microclimate conditions favorable to nonnative plants. Nonnative plant species most likely to be spread as a consequence of fire are those that (1) produce a high fuel load, (2) are adapted to survive and regenerate after fire, and (3) establish rapidly in newly burned areas. Grasses (particularly those that produce mats of dry material or retain a mass of standing dead leaves) that invade native forests and shrublands provide fuels that allow fire to burn areas that would not otherwise easily burn, including even the edges of wetter forests (Fujioka and Fujii 1980, in Cuddihy and Stone 1990, p. 93; DAntonio and Vitousek 1992, pp. 70, 73-74; Tunison et al. 2002, p. 122). Native woody plants may recover from fire to some degree, but fire tips the competitive balance toward nonnative species (National Park Service 1989, in Cuddihy and Stone 1990, p. 93).



For example, on a post-burn survey at Puuwaawaa on the island of Hawaii, an area of native *Diospyros* forest with undergrowth of the nonnative grass *Pennisetum setaceum*, Takeuchi noted no regeneration of native canopy is occurring within the Puuwaawaa burn area (Takeuchi 1991, p. 2). Takeuchi also stated, Burn events served to accelerate a decline process already in place, compressing into days a sequence which would ordinarily have taken decades (Takeuchi 1991, p. 4). The author concluded that in addition to increasing the number of fires, the nonnative *P. setaceum* acted to suppress establishment of native plants after a fire (Takeuchi 1991, p. 6).

There have been several recent fires on Oahu that have impacted rare or endangered species in coastal, lowland dry, and mesic habitats. Between 2004 and 2005, wildfires burned more than 360 ac (146 ha) of mesic habitat in Honouliuli Preserve, home to more than 90 rare and endangered plants and animals, and located along the windward side of the Waianae Mountains (TNC, in litt. 2005). In 2006, a fire at Kaena Point State Park burned 60 ac (24 ha) and encroached on endangered plants in Makua Military Reservation Army Training Area. In 2007, there was a significant fire in lowland dry and mesic habitat at Kaukonahua that crossed 12 gulches, eventually encompassing 5,655 ac (2,289 ha), negatively impacting seven endangered plant species. Occurrences of several native species were extirpated as a result of the fire. The Kaukonahua fire also provided pathways for nonnative ungulates (cattle, goats, and pigs) to access previously undisturbed areas. This fire opened gaps in previously densely vegetated areas allowing the growth of the invasive grass *Panicum maximum* (guinea grass), which is also used as a food source by cattle and goats. An area infested by *P. maximum* burned, and the grass resprouted blades over two feet in length only two weeks after the fire (U.S. Army Garrison 2007, p. 3). In 2009, there were two smaller fires which burned 200 ac (81 ha) at Manini Pali (Kaena Point State Park), and 3.8 ac (1.5 ha) at Makua Cave (at the mouth of Makua Valley). These examples of recent fires illustrate nonnative grass invasion leads to grass/fire cycles that convert native vegetation to grassland (DAntonio and Vitousek 1992, p. 77).

Several areas in the State of Hawaii, including some areas containing *Hylaeus* spp. habitat sites, are currently loosely addressed under fire management plans. For example, in 2003, the Army completed an Integrated Wildland Fire Management Plan (WFMP) for all of its Oahu training installations. This plan is currently being updated (U.S. Army 2009, pp. 4-73). The goal of the WFMP is to reduce the threat of wildfire that adversely affects listed and other rare species. Although no candidate yellow-faced bees are known from military land on Oahu, at least one species, *H. kuakea*, occurs on land roughly adjacent to military land along the Schofield Barracks East Range and could be impacted by fires caused by military activities, or conversely, could benefit from activities to suppress and control origination of fires either on or adjacent to military land.

Additionally, the State Division of Forestry and Wildlife (DOFAW) maintains a fire management program tasked with fire suppression activities targeted toward the protection of watershed areas, forest reserves, public hunting areas, wildlife and plant sanctuaries, and Natural Area Reserves (NARs). Their activities include the maintenance of firebreak roads, signage, and helicopter dip tanks; active fire control during fire outbreak; controlled burns when and where deemed necessary; fire training efforts, including education; and maintenance of a State fire management program website (<http://www.state.hi.us/dlnr/dofaw/fmp>). According to their website, DOFAW is involved in the protection of 3,360,000 acres (ac) statewide, which is approximately 81 percent of the State's land area.

In summary, while we are aware of fire management in some areas of the State, there is evidence that the repeated outbreak of fire within Hawaii's native coastal, lowland dry, and lowland mesic forests often leads to the irrevocable conversion of native to nonnative habitat (i.e., nonnative plant species). These nonnative habitats are unsuitable for nesting and foraging by *H. mana*. Therefore, we conclude fire is a significant ongoing threat to the habitat of *H. mana* in lowland mesic habitat.

#### Habitat Destruction and Modification by Recreational Activities

Some of the best habitat areas for the seven candidate *Hylaeus* species, including *H. mana*, are also popular

recreational sites, particularly those areas located within coastal habitat (Magnacca 2007a, p. 180). Human impacts at recreational sites can include removal or trampling of vegetation on or near trails and the compaction of vegetation by off-road vehicles (Magnacca 2007a, p. 180). However, we are not aware that the habitat of *H. mana* is actually being impacted by recreational activities currently.

In summary, while trampling and compaction of vegetation from human activities may negatively impact the habitat of the *H. mana* population, we have no basis to conclude these impacts would be at a scale that represents a threat to the species, and we believe this is a local rather than a range-wide problem for *H. mana*. Therefore, we conclude that recreational activities are not a threat to this species at this time.

#### Habitat Destruction and Modification by Hurricanes and Drought

Stochastic (random, naturally occurring) events, such as hurricanes and drought, can alter or degrade the habitat of *H. mana* directly by modifying and destroying native lowland mesic habitats (e.g., by mechanical damage to vegetation). Indirect effects include creating disturbed areas conducive to invasion by nonnative plants, which outcompete the native plants used by the species for foraging of nectar and pollen. We presume these events also alter microclimatic conditions (e.g., opening the tree canopy leading to an increase in habitat temperature, soil erosion, and decreasing soil moisture) so that the habitat no longer supports the native host plants necessary to *H. mana* for nectar and pollen foraging, as well as nesting.

Hurricanes affecting Hawaii were only rarely reported from ships in the area from the 1800s until 1949. Between 1950 and 1997, 22 hurricanes passed near or over the Hawaiian Islands, 5 of which caused serious damage (Businger 1998, pp. 1-2). In November 1982, Hurricane Iwa struck the Hawaiian Islands, with wind gusts exceeding 100 miles per hour (mph) (161 kilometers per hour (kph)), causing extensive damage, especially on the islands of Niihau, Kauai, and Oahu (Businger 1998, pp. 2, 6). Many forest trees were destroyed (Perlman 1992, pp. 1-9), which opened the canopy and facilitated the invasion of nonnative plants (Kitayama and Mueller-Dombois 1995, p. 671). Habitat alteration and degradation by nonnative plants is a threat to the habitat of *H. mana*, as described in the Habitat Destruction and Modification by Nonnative Plants section above. In September 1992, Hurricane Iniki, a category 4 hurricane with maximum sustained wind speeds recorded at 140 mph (225 kph), passed directly over the island of Kauai and close to the island of Oahu, causing significant damage to areas along Oahu's southwestern coast (Barbers Point or Kalaeloa, through Kaena) (Blake et al. 2007, p. 20). Damage by future hurricanes could further decrease the remaining native-plant-dominated habitat area that supports this species (Bellingham et al. 2005, p. 681).

*H. mana* may also be affected by temporary habitat loss (e.g., desiccation of habitats, die-off of host plants) associated with droughts, which are not uncommon on the Hawaiian Islands. Between 1860 and 2002, the Hawaiian Islands were affected by approximately 49 periods of drought (Giambelluca et al. 1991, pp. 3-4; Hawaii Commission on Water Resource Management 2009a and 2009b). These drought events lead to an increase in the number of forest and brush fires (Giambelluca et al. 1991, p. v), causing a reduction of native plant cover and habitat (DAntonio and Vitousek 1992, pp. 77-79). With populations that have likely been reduced in both abundance and geographic distribution, even such a temporary loss of habitat can have a severe negative impact on *H. mana* if, for example, the host plants for nectar and pollen foraging are lost for one or more seasons. Because small populations are demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio, stochastic events such as hurricanes pose the threat of immediate extinction of a species with a very small and geographically restricted distribution such as *H. mana* (Lande 1988, p. 1,455).

In summary, natural disasters, such as hurricanes and drought, represent a significant threat to lowland mesic habitats and *H. mana*, endangering its chance for conservation and recovery. These types of events are known to cause significant habitat damage, and because the species now persists in low numbers within a restricted range, it is more vulnerable to these events and less resilient to such habitat disturbances. Hurricanes and drought, even though unpredictable, have been and are expected to continue to be threats to the *H. mana*, and they therefore pose immediate and ongoing threats to the species and its habitat.

## Habitat Destruction and Modification by Climate Change

Climate change will be a particular challenge for biodiversity because the interaction of additional stressors may push species beyond their ability to survive (Lovejoy et al. 2005, pp. 325-326). The synergistic implications of climate change and habitat fragmentation are the most threatening facet of climate change for biodiversity (Lovejoy et al. 2005, p. 4). The magnitude and intensity of the impacts of global climate change and increasing temperatures on native Hawaiian ecosystems are unknown; we are not aware of climate change studies specifically related to the lowland mesic habitat area occupied by *H. mana*, or to other *Hylaeus* bee species. Based on the best available information, climate change impacts could include the loss of native plant species that comprise the habitat in which *H. mana* occurs (Pounds et al. 1999, pp. 611-612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246, 14,248); however, because no climate change studies have looked at the effects to coastal and lowland habitat, we have no way of predicting the amount or extent of any such possible habitat loss. Because the host plant habitat of *H. mana* is well outside of the tidal and immediate near shore zone, we do not expect any direct effects to its habitat from sea level rise itself.

In addition, *H. mana* may be vulnerable to changes in precipitation caused by global climate change. However, future changes in precipitation are uncertain because they depend in part on how El Nino (a disruption of the ocean atmospheric system in the tropical Pacific having important global consequences for weather and climate) might change, and reliable projections of changes in El Nino have yet to be made (Benning et al. 2002, pp. 14,248-14,249). Oki (2004, p. 4) has noted long-term evidence of decreased precipitation and stream flow in the Hawaiian Islands, based upon evidence collected by stream gauging stations. This long-term drying trend, coupled with periodic El Nino-caused drying events, has created a pattern of severe and persistent stream dewatering events (Polhemus, in litt 2008, p. 26). Future changes in precipitation and the forecast of those changes are highly uncertain because they depend, in part, on how the El Nino-La Nina (a different disruptive extreme weather and climate pattern that can alternate with El Nino) weather cycle might change (Hawaii Climate Change Action Plan 1998, pp. 2-10).

If precipitation is significantly reduced, *H. mana* may be among the species most vulnerable to extinction, with possible impacts expected to include habitat loss and alteration or changes in disturbance regimes (e.g., storms and hurricanes), in addition to possible direct physiological stress of an unknown nature, which could potentially cause the species to seek out less suitable habitats as its preferred habitat become degraded. The probability of a species going extinct as a result of these factors increases when ranges are restricted, habitat decreases, and population numbers decline (Intergovernmental Panel on Climate Change 2007, p. 8). Such is the case for *H. mana*, which is characterized by a limited climatic range and restricted habitat requirements, small population size, and low number of individuals. However, without reliable predictions of the amount and extent of anticipated precipitation change, we are unable to determine whether precipitation changes would result in negative impacts to *H. mana* at this time.

In summary, *H. mana*, like most insects, is presumed to have limited environmental tolerances. This species also has a limited range and restricted habitat requirements (Daly and Magnacca 2003, p. 11). The projected effects of global climate change and increasing temperatures on *H. mana* would likely be related to changes in microclimatic conditions in its habitats. These changes may also lead to the loss of native plant species due to direct physiological stress, the loss or alteration of habitat, increased competition from nonnative bee species, and changes in disturbance regimes (e.g., fire, storms, and hurricanes). Therefore, we believe *H. mana* will be exposed to projected environmental impacts that may result from changes in climate, and subsequent impacts to its habitat (Pounds et al. 1999, pp. 611-612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246, 14,248), and we do not anticipate a reduction in this ongoing threat any time in the near future. However, because the specific and cumulative effects of climate change on this species are presently unknown, we are not able to determine the magnitude of this potential threat with confidence or precision.

Summary of Factor A - The present or threatened destruction, modification, or curtailment of its habitat or range

*H. mana* is dependent upon the persistence of native Hawaiian plants and their increasingly rare associated habitat types, particularly lowland mesic habitat areas. As identified above in our Factor A analysis, the native habitat on which *H. mana* depend have been drastically directly altered during the last century, with many areas either converted for development or agriculture, or indirectly altered due to the effects of nonnative ungulates, nonnative plants, and fire. Habitat conversion and loss of host plants, and other stochastic events (e.g., hurricanes and drought), are all contributing factors to the present and threatened destruction, modification, and curtailment of the habitat and range of *H. mana*.

Land conversion and fragmentation of remaining lowland mesic habitat is continuing throughout this species known range, particularly due to the effects of feral ungulates, fire, and nonnative plants (Magnacca, in litt. 2011, p. 78). We anticipate habitat conversion and fragmentation to continue, and likely increase, throughout its known range. As discussed above, *H. mana* has experienced significant habitat losses. As more habitat becomes unsuitable, we expect its population declines to continue or accelerate.

We have evaluated the best scientific and commercial information available regarding the present or threatened destruction, modification, or curtailment of *H. mana* habitat or range. Based on the current and ongoing habitat issues identified, their synergistic effects, and their likely continuation, we have determined this factor poses a significant threat to *H. mana*.

## **B. Overutilization for commercial, recreational, scientific, or educational purposes:**

We are unaware of any collections of *Hylaeus mana* by recreational or insect enthusiast collectors. However, insect collecting is a valuable component of research, including taxonomic work, and is often necessary to document the existence of populations and population trends. Based on comments received in response to the 90-day finding for this species, *H. mana* is not believed to be particularly threatened by over-collection (Magnacca, in litt. 2010, p. 2).

## **C. Disease or predation:**

### **Disease**

As of May 2013, we are not aware of any information indicating disease presents a threat to *Hylaeus mana*.

### **Predation**

#### Predation by Nonnative Ants

Ants are known to prey upon *Hylaeus* species (Medeiros et al. 1986, pp. 45-46; Reimer 1994, p. 17), thereby directly eliminating them from specific areas. In one particular study, nests of *Nesoprosopis* sp., an endemic ground-nesting bee, could not be found in ant-infested plots but were commonly encountered in ant-free sites of the same habitat. *Nesoprosopis* was reduced to a subgenus of *Hylaeus* in 1923 (Meade-Waldo 1923, p. 1). Ants are not a natural component of Hawaii's arthropod fauna, and the native *Hylaeus* species of the islands evolved in the absence of predation pressure from ants. Ants can be particularly destructive predators because of their high densities, recruitment behavior, aggressiveness, and broad range of diet (Reimer 1993, pp. 17-18). The threat of ant predation on *H. mana* is amplified by the fact that most ant species have winged reproductive adults (Borror et al. 1989, p. 738) and can quickly establish new colonies in suitable habitats (Staples and Cowie 2001, p. 55). In addition, these attributes allow some ants to destroy otherwise geographically isolated populations of native arthropods (Nafus 1993, pp. 19, 22-23). Ants have not been observed preying upon *H. mana*. However, at least one or more of the most aggressive and widespread species (discussed below) occur in the known population site of *H. mana* and are presumed to be a serious threat due to the impact of predation.

At least 47 species of ants are known to be established in the Hawaiian Islands (Hawaii Ants 2008, pp. 1-11).

Native insect fauna, likely including *H. mana* (Zimmerman 1948, p. 173; Reimer et al. 1990, pp. 40-43; HEAR 2005, pp. 1-2), have been severely impacted by at least four particularly aggressive ant species: *Pheidole megacephala* (big-headed ant), *Anoplolepis gracilipes* (long-legged or yellow crazy ant), *Solenopsis papuana* (no common name), and *Solenopsis geminata* (no common name). Numerous other species of ants are recognized as threats to Hawaii's native invertebrates, and an unknown number of new species of ants are established every few years (Staples and Cowie 2001, p. 53). Due to their preference for drier habitat sites, ants are more likely to occur in high densities in the mesic habitat currently occupied by *H. mana* (Reimer 1994, p. 12).

*Pheidole megacephala* originated in central Africa (Krushelnycky et al. 2005, p. 24) and was first reported in Hawaii in 1879 (Krushelnycky et al. 2005, p. 24). This species is considered one of the most invasive and widely distributed ants in the world (Krushelnycky et al. 2005, p. 5). In Hawaii, this species is the most ubiquitous ant species found, from coastal to mesic habitat up to 4,000 ft (1,219 m) in elevation, including within the habitat of *H. mana*. With few exceptions, native insects have been eliminated in habitats where *P. megacephala* is present (Perkins 1913, p. xxxix; Gagne 1979, p. 81; Gillespie and Reimer 1993, p. 22). Consequently, *P. megacephala* represents a threat to the population of *H. mana* within its mesic habitat on Oahu (Reimer 1993, p. 14; Reimer 1994, p. 17; Daly and Magnacca 2003, pp. 9-10).

*Anoplolepis gracilipes* appeared in Hawaii in 1952, and now occurs on Hawaii, Kauai, Maui, and Oahu (Reimer et al. 1990, p. 42; Antweb 2011). It inhabits low- to mid-elevation (less than 2,000 ft (600 m)) rocky areas of moderate rainfall (less than 100 in (250 cm) annually) (Reimer et al. 1990, p. 42). Although surveys have not been conducted to ascertain this species' presence in the known habitat occupied by *H. mana*, we may presume that *A. gracilipes* likely occurs within the identified population site based upon anecdotal evidence of their expanding range and their preference (as indicated where the species is most commonly collected) for coastal to mesic forest habitats (Antweb 2011). Direct observations indicate Hawaiian arthropods are susceptible to predation by this species; Gillespie and Reimer (1993, p. 21) and Hardy (1979, pp. 37-38) documented the complete extirpation of several native insects within the Kipahulu area on Maui after this area was invaded by *A. gracilipes*. Lester and Tavite (2004, p. 391) found that *A. gracilipes* in the Tokelau Atolls (New Zealand) can form very high densities in a relatively short period of time with locally serious consequences for invertebrate diversity. Densities of 3,600 individuals collected in pitfall traps within a 24-hour period were observed, as well as predation upon invertebrates ranging from crabs to other ant species. On Christmas Island in the Indian Ocean, numerous studies have documented the range of impacts to native invertebrates, including the *Gecarcoidea natalis* (red land crab), as a result of predation by supercolonies of *A. gracilipes* (Abbott 2006, p. 102). *A. gracilipes* ants have the potential as predators to profoundly affect the endemic insect fauna in territories they occupy. Studies comparing insect populations at otherwise similar ant-infested and ant-free sites found extremely low numbers of large endemic noctuid moth larvae (*Agrostis* spp. and *Peridroma* spp.) in ant-infested areas. Nests of ground-nesting colletid bees (*Nesoprosopis* spp.) were eliminated from ant-infested sites (Reimer et al. 1990, p. 42). Although only cursory observations exist in Hawaii (Reimer et al. 1990, p. 42), we believe *A. gracilipes* are a threat to the population of *H. mana* within its mesic habitat on Oahu.

*Solenopsis papuana* is the only abundant, aggressive ant that has invaded intact mesic to wet forest, as well as coastal and lowland dry habitats. This species occurs from sea level to over 2,000 ft (600 m) on all of the main Hawaiian Islands, and is still expanding its range (Reimer 1993, p. 14). Although surveys have not been conducted to ascertain the presence of *S. papuana* in the known habitat site occupied by *H. mana*, because of the expanding range of this species and its widespread occurrence in mesic habitats, it is a possible threat to the known population of *H. mana* (Reimer et al. 1990, p. 42; Reimer 1993, p. 14).

Like *Solenopsis papuana*, *S. geminata* is also considered a significant threat to native invertebrates (Gillespie and Reimer 1993) and occurs on all the main Hawaiian Islands (Reimer et al. 1990; Nishida 1997). Found in drier areas of the Hawaiian Islands, it has displaced *P. megacephala* as the dominant ant in some localities (Wong and Wong 1988, p. 175). Known to be a voracious nonnative predator in many areas to where it has spread, the species was documented to significantly increase fruit fly mortality in field studies in Hawaii

(Wong and Wong 1988, p. 175). In addition to predation, *S. geminata* workers tend honeydew-producing members of the Homoptera suborder, especially mealybugs, which can impact plants directly and indirectly through the spread of disease (Manaaki Whenua Landcare Research 2011).

*Solenopsis geminata* was included among the eight species ranked as having the highest potential risk to New Zealand in a detailed pest risk assessment for the country (Global Invasive Species Database 2011), and is included as one of five ant species listed among the 100 of the Worlds Worst invaders (Manaaki Whenua Landcare Research 2011).

Although surveys have not been conducted to ascertain the presence of *S. geminata* in the known habitat occupied by *H. mana*, because of the expanding range of this species and its widespread occurrence in mesic habitats, it is a possible threat to the known population of *H. mana* (Wong and Wong 1988, p. 175).

*Hylaeus* populations are known to be drastically reduced in ant-infested areas (Medeiros et al. 1986, pp. 45-46; Stone and Loope 1987, p. 251; Cole et al. 1992, pp. 1313, 1317, 1320; Reimer 1994, p. 17). The presence of ants in the low-elevation habitat currently occupied by *H. mana* may increase the uncertainty of this species recovery within this area (Reimer 1994, pp. 17-18; Daly and Magnacca 2003, pp. 9-10). Although the primary impact of ants on the native invertebrate fauna is via predation (Reimer 1994, p. 17), they also compete for nectar (Howarth 1985, p. 155; Hopper et al. 1996, p. 9; Holway et al. 2002, pp. 188, 209; Daly and Magnacca 2003, p. 9; Lach 2008, p. 155) and nest sites (Krushelnycky et al. 2005, pp. 6-7). Some ant species may impact *H. mana* indirectly as well, by consuming seeds of native plants, thereby reducing the plants recruitment and fecundity (Bond and Slingsby 1984, p. 1,031). Several studies (Krushelnycky 2005, p. 9; Lach 2008, p. 155) suggest a serious ecosystem-level effect of invasive ants on pollination. Where ranges overlap, ants compete with native pollinators such as *Hylaeus* bees and preclude them from pollinating native plants. For example, *P. megacephala* is known to actively rob nectar from flowers without pollinating them (Howarth 1985, p. 157). Lach (2008, p. 155) found that *Hylaeus* bees that regularly consume pollen from flowers of *Metrosideros polymorpha* were entirely absent from trees with flowers exposed to foraging by *P. megacephala*.

The rarity or disappearance of native *Hylaeus* species, including *H. mana*, from historically documented localities over the past 100 years is due to a variety of factors. Although we have no direct information that conclusively correlates the rarity of populations of *H. mana* due to the establishment of nonnative ants, severe predation of other *Hylaeus* species by ants has been documented, resulting in clear reductions in populations. We expect similar predation impacts to *H. mana* to continue as a result of the widespread presence of ants throughout the Hawaiian Islands, their highly efficient and non-specific predatory behavior, and their ability to quickly disperse and establish new colonies. Therefore, we conclude that predation by nonnative ants represents a serious threat to the continued existence of *H. mana*, now and into the future.

#### Predation by Nonnative Western Yellow Jacket Wasps

The *Vespula pensylvanica* (western yellow jacket wasp) is a potentially serious threat to *H. mana* (Gambino et al. 1987, p. 170; Wilson et al. 2009, pp. 1-5). *V. pensylvanica* is a social wasp species native to the mainland of North America. It was first reported from Oahu in the 1930s (Sherley 2000, p. 121), and an aggressive race became established in 1977 (Gambino et al. 1987, p. 170). In temperate climates, *V. pensylvanica* has an annual life cycle, but in Hawaii's tropical climate, colonies of this species persist through a second year, allowing them to have larger numbers of individuals (Gambino et al. 1987, p. 170) and thus a greater impact on prey populations. Most colonies are found between approximately 2,000 and 3,500 ft (approximately 600 and 1,050 m) in elevation (Gambino et al. 1990, p. 1,088), although they can also occur at sea level. *V. pensylvanica* is known to be an aggressive, generalist predator (Gambino et al. 1987, p. 170) and has been documented preying upon Hawaiian *Hylaeus* species (although not specifically upon *H. mana*) (Wilson et al. 2009, p. 2). However, predation by *V. pensylvanica* is a potentially significant threat to *H. mana* because of the wasps likely presence in habitat occupied by the species combined with its small population size. This may present a particular threat to *H. mana* because the species is known from only four

population sites. It has been suggested *V. pensylvanica* may compete for nectar with *Hylaeus* species, but we have no information to suggest this represents a threat to *H. mana*.

#### Predation by Nonnative Parasitoid Wasps

Native and nonnative parasitoid wasps are known to parasitize some *Hylaeus* species on Oahu, and may pose a threat to the four populations of *H. mana*, (Daly and Magnacca 2003, p. 10). While the available information indicates some Oahu *Hylaeus* larvae have been parasitized (and subsequently killed) by parasitoid wasps from the Encyrtidae and Eupelmidae families, it is unknown whether these wasps also utilize *H. mana* as nutritional hosts for their larvae (Daly and Magnacca 2003, p. 98). We are concerned that *H. mana* may be exposed to wasp parasitism, but we are unaware of any information to indicate this is a threat to this species.

#### Summary of Factor C Disease or predation

We do not find evidence that disease is currently impacting *H. mana*, nor do we have information to indicate disease outbreaks will occur in the future. Although we have no direct information that conclusively correlates the decrease in populations of this species due to the establishment of *V. pensylvanica*, severe predation of other *Hylaeus* species by yellow jacket wasps has been documented, resulting in clear reductions in populations. We expect similar predation impacts to *H. mana* to continue as a result of the widespread presence of *V. pensylvanica* in many areas throughout the Hawaiian Islands, their highly efficient and non-specific predatory behavior, and their ability to quickly disperse and establish new colonies.

While we are concerned that *H. mana* may be threatened by wasp parasitism on Oahu, we are unaware of any information to indicate this is a threat to this species at this time, or that it is likely to become so in the future. The presence of nonnative ants in nearly all lowland habitat currently occupied by *H. mana*, combined with the near extirpation of native insects in these areas, suggest predation by nonnative ants is a serious threat to the species. Observations and reports have documented that ants are particularly destructive predators because of their high densities, broad ranges of diet, and ability to establish new colonies in otherwise geographically isolated locations because the reproductive adult ants are able to fly. Because the ranges of *Pheidole megacephala*, *Anoplolepis gracilipes*, *Solenopsis geminata*, and *Solenopsis papuana* overlap the range of *H. mana*, and based on their observed predatory behavior at other locations where they occur, these nonnative predators represent an imminent and serious threat to *H. mana*. Unless these aggressive, nonnative ant predators are eliminated or controlled, we expect this threat to continue or increase. Furthermore, a decrease in the amount and distribution of suitable host plants for foraging could indirectly impact *H. mana* by forcing the species to seek less optimal, but predator-free, foraging sites.

### **D. The inadequacy of existing regulatory mechanisms:**

Currently, there are no Federal, State, or local laws, treaties, or regulations that specifically conserve or protect *Hylaeus mana* from the numerous threats facing this species. However, there are some regulations that potentially address the threats posed by introduced, nonnative species; these are discussed below.

#### Inadequate Protection from Nonnative Ungulates

Nonnative ungulates pose a major ongoing threat to *H. mana* through destruction and degradation of its habitat. Although some public hunting areas are fenced to prevent the movement of nonnative ungulates to other areas, there are currently no Federal, State, or local laws, treaties, or regulations that adequately address the threats from nonnative ungulates to *H. mana* habitat. The absence of regulatory mechanisms exacerbates the threats discussed under Factor A.

#### Inadequate Protection from Introduction of Nonnative Species

The Hawaii Department of Agriculture (HDOA) is the lead State agency in protecting Hawaii's agricultural and horticultural industries, animal and public health, natural resources, and environment from the introduction of nonnative, invasive species (HDLNR 2003, p. 3-10). While there are several State agencies (HDOA, HDLNR, and Hawaii Department of Health) authorized to prevent the entry of pest species into the State, the existing regulations are inadequate for the reasons discussed in the sections below.

In 1995, a partnership called the Coordinating Group on Alien Pest Species (CGAPS), comprised primarily of managers from every major Federal, State, county, and private agency and organization involved in invasive species work in Hawaii, was formed in an effort to influence policy and funding decisions, improve communication, increase collaboration, and promote public awareness (CGAPS 2009). This group facilitated the formation of the Hawaii Invasive Species Council (HISC), which was created by gubernatorial executive order in 2002 to coordinate local initiatives for the prevention and control of invasive species by providing policy-level direction and planning for the State departments responsible for invasive species issues. In 2003, the governor signed into law Act 85, which conveys statutory authority to the HISC to coordinate approaches among the various State and Federal agencies, and international and local initiatives, for the prevention and control of invasive species (HDLNR 2003, p. 3-15; HISC 2009a; Haw. Rev. Stat. section 194-2(a)). Some of the recent priorities for the HISC include interagency efforts to control nonnative species such as the plants *Miconia calvescens* (miconia) and *Cortaderia* sp. (pampas grass), coqui frogs (*Eleutherodactylus coqui*), and ants (HISC 2009). However, in October 2009, HISC approved a 2010 budget that, due to a tighter economy in Hawaii and anticipated budget cuts in State funding support, resulted in a 50 percent reduction in funding with an anticipated setback in conservation achievements and the loss of experienced, highly trained staff (HISC 2009b).

#### Inadequate Regulatory Control of Nonnative Invertebrate Species

As noted above (see Factor C, Disease and Predation), predation by nonnative ants and the nonnative *Vespula pensylvanica* is a potentially significant threat to *H. mana*. Commercial shipping and air cargo, as well as biological introductions to Hawaii, have resulted in the establishment of over 3,372 species of nonnative insects (Howarth 1990, p. 18; Staples and Cowie 2001, p. 52), with an estimated continuing establishment rate of 20 to 30 new species per year (Beardsley 1962, p. 101; Beardsley 1979, p. 36; Staples and Cowie 2001, p. 52). The prevention and control of introduced pest species in Hawaii is the responsibility of Hawaii State government and Federal agencies, along with a few private organizations. Even though these agencies have regulations and some controls in place, complete control of introduced pest species is difficult to achieve. Consequently, the introduction and movement of nonnative invertebrate pest species, including nonnative ants and *V. pensylvanica*, between islands and from one watershed to the next, continues.

#### Inadequate Regulatory Control of Nonnative Plant Species

Nonnative plants destroy and modify habitat throughout the range of *H. mana*. As such, they represent a significant and immediate threat to this species. In addition, nonnative plants have been shown to outcompete native plants and convert native-dominated plant communities to nonnative plant communities (see Factor A Habitat Destruction and Modification by Nonnative Plants). The HDOA regulates the import of plants into the State from domestic origins under Hawaii State law (Haw. Rev. Stat. Ch. 150A). While all plants require inspection upon entry into the State and must be apparently free of insects and diseases, not all plants require import permits. Parcels brought into the State by mail or cargo must be clearly labeled as Plant Materials or Agricultural Commodities, but, given budget constraints and an insufficient number of personnel, it is unlikely that all of these parcels are inspected or monitored prior to delivery in Hawaii. Shipments of plant material into Hawaii must be accompanied by an invoice or packing manifest listing the contents and quantities of the items imported, although it is unclear if all of these shipments are inspected or monitored prior to delivery (HDOA 2009). There are only 12 plant crops regulated (H.A.R. chapter 4-70) to some degree: sugarcane and grasses, pineapple and other bromeliads, coffee, cruciferous vegetables, orchids, banana, passion fruit, pine, coconut, and palms, and any host plants that harbor either Caribbean fruit fly or European corn borer (HDLNR 2003, p. 3-11). The HDOA also maintains the State list of noxious weeds, and



these plants are restricted from entry into the State except by permit from the HDOAs Plant Quarantine Branch.

Although the State has general guidelines for the importation of plants, and regulations are in place regarding the plant crops mentioned above, the intentional or inadvertent introduction of nonnative plants outside the regulatory process and movement of species between islands and from one watershed to the next continues, which represents a threat to native flora and fauna for the reasons described above. In addition, government funding is inadequate to provide for sufficient inspection services and monitoring. One study concluded plant importation laws virtually ensure new invasive plants will be introduced via the nursery and ornamental trade, and outreach efforts cannot keep up with the multitude of new invasive plants being distributed. The author states the only thing wide-scale public outreach can do in this regard is to let the public know new invasive plants are still being sold, and suggest that people should ask for noninvasive or native plants instead (Martin, in litt. 2007, p. 9).

On the basis of the above information, existing regulatory mechanisms do not adequately protect *H. mana* from the threat of new introductions of nonnative species and the continued expansion of nonnative species populations on and between islands and watersheds. Nonnative species may directly compete with, prey upon, consume, or modify or destroy the habitat of *H. mana* for food, space, and other necessary resources. Because current Federal, State, and local laws, treaties, and regulations are inadequate to prevent the introduction and spread of nonnative species from outside the State of Hawaii, as well as between islands and watersheds, the threats from these introduced species remain immediate and significant due to an inadequacy of existing regulatory mechanisms.

#### Summary of Factor D The inadequacy of existing regulatory mechanisms

Existing regulatory mechanisms and agency policies do not address the primary threats to *H. mana* and its habitat from nonnative species including ungulates, plants, and arthropods, and the States current management of nonnative game mammals does not prevent the degradation and destruction of habitat of *H. mana* (see discussion under Factor A).

We consider the threat from inadequate regulatory mechanisms to be immediate and significant for the following reasons:

1. Existing State and Federal regulatory mechanisms are not preventing the introduction and spread of nonnative species between islands and watersheds; and
2. Habitat-altering nonnative plant species (Factor A) and predation by nonnative animal species (Factor C) pose major ongoing threats to *H. mana*. Because existing regulatory mechanisms are inadequate to maintain habitat for *H. mana* and to prevent the spread of nonnative species, the inadequacy of existing regulatory mechanisms is considered to be a significant and immediate threat to *H. mana*.

#### **E. Other natural or manmade factors affecting its continued existence:**

Species endemic to single islands or known from few, widely dispersed locations are inherently more vulnerable to extinction than widespread species because of the higher risks from genetic bottlenecks, random demographic fluctuations, climate change, and localized catastrophes such as hurricanes, landslides, and drought (Lande 1988, p. 1,455; Mangel and Tier 1994, p. 607; Pimm et al. 1988, p. 757). These problems can be further magnified when populations are few and restricted to a limited geographic area, and the number of individuals is very small. Populations with these characteristics face an increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors, in a process described as an extinction vortex (Gilpin and Soulé 1986, pp. 24-25). Small, isolated populations often exhibit a reduced level of genetic variability or genetic depression due to inbreeding, which diminishes a species capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (Frankham 2003, pp. S22-S29; Soulé 1986, pp. 31-34). The negative impacts

associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes can be further magnified by synergistic interactions with other threats.

The one known *Hylaeus mana* population is likely more vulnerable to habitat change and stochastic events due to low genetic variability (Daly and Magnacca 2003, p. 3; Magnacca 2007, p. 173). Although *H. mana* was only discovered relatively recently, researchers believe this species was once more widespread when its lowland mesic habitat was not highly fragmented and degraded by invasive species, as is currently the case (Magnacca, in litt. 2011, p. 95). Additionally, the small number of populations known for this species increases its risk of extinction due to stochastic events such as hurricanes, wildfires, or prolonged drought (Jones et al. 1984, p. 209; Smith and Tunison 1992, p. 398).

The recurrence intervals for stochastic events (e.g., wildfires, prolonged drought, and hurricanes) cannot be predicted, which introduces some uncertainty regarding potential effects to *H. mana*. The fact that a species is potentially vulnerable to stochastic processes does not necessarily mean it is reasonably likely to experience or have its status affected by a given stochastic process within timescales meaningful under the Act. Because of its small number of populations, negative impacts to *H. mana* from hurricanes, wildfires, and drought would be likely if these events occur. Because these events have been documented on Oahu and other Hawaiian islands in the past, we believe that they represent an ongoing threat to this species, although the specific timing, location, or magnitude is unknown. The threat from fire is unpredictable, but omnipresent in habitats that have been invaded by nonnative, fire-prone grasses. Hurricanes and drought conditions present an ongoing and ever-present threat, because they can occur at any time, although the incidence and magnitude of specific events is not predictable.

#### Competition with Nonnative Insects

There are 15 known species of nonnative bees in Hawaii (Snelling 2003, p. 342), including two nonnative *Hylaeus* species (Magnacca 2007, p. 188). Most nonnative bees inhabit areas dominated by nonnative vegetation and do not compete with native Hawaiian bees for foraging resources (Daly and Magnacca 2003, p. 13). *Apis mellifera*, the European honey bee, is an exception; this social species is often very abundant in areas with native vegetation and aggressively competes with *Hylaeus* for nectar and pollen (Hopper et al. 1996, p. 9; Daly and Magnacca 2003, p. 13; Snelling 2003, p. 345).

*Apis mellifera* was first introduced to the Hawaiian Islands in 1875, and currently inhabits areas from sea level to the upper tree line boundary (Howarth 1985, p. 156). *A. mellifera* individuals have been observed foraging on *Hylaeus* host plants such as *Scaevola* spp. and *Sesbania tomentosa* (ohai) (Hopper et al. 1996, p. 9; Daly and Magnacca 2003, p. 13; Snelling 2003, p. 345). Although we lack information indicating Hawaiian *Hylaeus* populations have declined because of competition with *A. mellifera* for nectar and pollen, *A. mellifera* does forage in *Hylaeus* spp. habitat and may exclude *Hylaeus* spp. (Magnacca 2007, p. 188; Lach 2008, p. 155). *Hylaeus* species do not occur in native habitat where there are large numbers of *A. mellifera* individuals, but the impact of smaller, more moderate populations is not known (Magnacca 2007, p. 188). Nonnative, invasive bees are widely documented to decrease nectar volumes and usurp native pollinators (Lach 2008, p. 155). There are also indications that populations of *A. mellifera* are not as vulnerable as *Hylaeus* bees to predation by nonnative ant species (see Factor C. Disease and Predation). Lach (2008, p. 155) observed that *Hylaeus* bees that regularly collect pollen from the flowers of *Metrosideros polymorpha* trees were entirely absent from trees with flowers visited by *Pheidole megacephala*, while visits by *A. mellifera* were not affected. As a result, *A. mellifera* may have a competitive advantage over *Hylaeus* spp., as it is not excluded by *P. megacephala* (Lach 2008, p. 155).

Other nonnative bees found in areas of native vegetation include *Ceratina* species (carpenter bees), *Hylaeus albonitens* (Australian colletid bees), and *Lasioglossum impavidum* (no common name) (Magnacca 2007, p. 188). While it has been suggested these nonnative bees may impact native *Hylaeus* bees through competition for pollen based on their similar size and flower preferences, there is no information that demonstrates these nonnative bees forage on *Hylaeus* host plants (Magnacca 2007, p. 188). It has also been suggested parasitoid

wasps may compete for nectar with native *Hylaeus* species (Daly and Magnacca 2003, p. 10); however, information demonstrating nonnative parasitoid wasps forage on the same host plants as *H. mana* is unavailable.

We acknowledge the potential for negative impacts on *H. mana* from competition with *A. mellifera* for nectar and pollen (Magnacca 2007, p. 188). In addition, one study in Hawaii suggests *A. mellifera* may have an additional advantage for collecting pollen and nectar because it may not be negatively affected by the presence of predatory *P. megacephala* individuals on native vegetation (Lach 2008, p. 155). Competition with *A. mellifera* may be a potential threat to *H. mana* because: (1) honey bees forage on *Hylaeus* host plant species, (2) they may exclude *Hylaeus* spp. from those resources (*Hylaeus* spp. are never found foraging in the presence of *A. mellifera*), and (3) *A. mellifera* may have a competitive advantage over Hawaiian *Hylaeus* sp., as one study suggests honey bees are not negatively affected by the presence of *P. megacephala* individuals on native vegetation to the extent the *Hylaeus* species may be. *A. mellifera* have been known to exclude other *Hylaeus* species, and it is well-documented that they forage in native plant areas. However, the best available scientific information indicates that competition with *A. mellifera* may represent a threat to *H. mana*, but the threat is of unknown magnitude, and additional research would be helpful to better understand this interaction.

We have no information indicating other species of nonnative bees or parasitoid wasps negatively impact the population of *H. mana* due to competition for nectar and pollen, and have, therefore, determined that competition with other species of nonnative bees or parasitoid wasps is not a threat.

#### Summary of Factor E Other natural or manmade factors affecting its continued existence

The small number of populations of *H. mana* and its inherently small gene pool increases its risk of extinction due to stochastic events such as hurricanes, wildfires, and drought, which although unpredictable, represent an ongoing and significant threat to the species. We have no information indicating other nonnative bees or parasitoid wasps compete for nectar and pollen on *Hylaeus* host plants. Therefore, we have determined that competition with these species does not present a significant threat to *H. mana*. While *A. mellifera* forage in native plant areas and have been known to exclude other *Hylaeus* species, the best available information does not indicate competition between *A. mellifera* and *H. mana* is a significantly quantifiable threat.

### **Conservation Measures Planned or Implemented :**

The *Hylaeus mana* population site along the Manana Trail within the Ewa Forest Reserve is protected from development, urbanization, and conversion to agriculture by the State. This area is somewhat managed to restore native habitat and to reduce or eliminate many of the common threats to the native plant communities found there, including feral ungulates and wildfire. However, existing regulatory mechanisms are inadequate to entirely provide the necessary active management needed in this area or to protect the habitat of other possible populations outside of this area (see discussion under Factor D, above). Conservation of *H. mana* will require active management of its known population site, involving exclusion and removal of feral ungulates, control and removal of nonnative plant and insect species, and the restoration of native vegetation (Magnacca 2007, p. 185).

### **Summary of Threats :**

*Hylaeus mana* is known from only four population sites within rare lowland mesic habitat on the island of Oahu, and the species remains threatened by habitat degradation from nonnative feral ungulates, nonnative plants, fire, stochastic events, inadequate regulatory protection, and climate change. The species itself is at risk from inadequate regulatory protection, small population size, and predation by and competition with

nonnative insect species. We conclude there is sufficient information to develop a proposed rule for *H. mana*, and we find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

**For species that are being removed from candidate status:**

\_\_\_\_\_ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

**Recommended Conservation Measures :**

Because existing regulatory mechanisms are inadequate to provide the necessary active management to protect *Hylaeus mana*, conservation of the species will require the active control and management of natural areas where populations are known to exist. This active management will involve exclusion and removal of feral ungulates, control and removal of nonnative plant and insect species, improved and increased wild fire management and control, and the restoration of native vegetation. The continued impact of development, fire, feral ungulates, invasive ants, and the loss of native vegetation to invasive plant species will undoubtedly have a negative impact on the remaining population of *H. mana* and may cause its extinction if habitat is not managed for conservation of this species (Magnacca 2007, p. 185). Necessary management actions should include:

- Protecting host plant populations from feral ungulates including pigs, goats, deer, and cattle;
- Researching and implementing methods to control nonnative plant species within its lowland mesic habitat;
- Researching and implementing control methods, such as poison baiting, for nonnative social insect species including ants;
- Further research into the effects of *Apis mellifera* on native *Hylaeus* spp.; and
- Conducting field surveys at known locations and in suitable habitat.

**Priority Table**

Magnitude	Immediacy	Taxonomy	Priority
<b>High</b>	<b>Imminent</b>	Monotypic genus	1
		<b>Species</b>	<b>2</b>
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

**Rationale for Change in Listing Priority Number:**

## **Magnitude:**

This species is highly threatened by feral ungulates that degrade and destroy host plant habitat and nonnative plants that degrade habitat and compete with native host plants for light, space, and nutrients. Predation by nonnative social insects is also a serious threat. Threats to the native forest habitat of *Hylaeus mana*, and to individuals of this species, occur throughout its range and are expected to continue or increase without their control or eradication. No known conservation measures have been taken to date to specifically address these threats.

## **Imminence :**

Threats to *Hylaeus mana* host plant habitat from feral ungulates and nonnative plants and direct predation by nonnative social insects are considered imminent because they are ongoing.

☐ Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

## **Emergency Listing Review**

☐ No Is Emergency Listing Warranted?

The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of the species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

## **Description of Monitoring:**

Much of the information in this form is based upon five petitions we received on, and dated March 23, 2009, from Scott Hoffman Black, Executive Director of the Xerces Society. The five petitions requested that seven species of Hawaiian yellow-faced bees (including *Hylaeus mana*) be listed as Endangered under the Act and critical habitat be designated. Each petition contained information regarding the species taxonomy and ecology, historical and current distribution, present status, and current and potential threats. We acknowledged the receipt of the petitions in a letter to Mr. Black, dated May 8, 2009. In that letter we also stated that issuing an emergency regulation temporarily listing the species under section 4(b)(7) of the Act was not warranted at that time. We published the 90-day finding in the Federal Register on June 16, 2010 (75 FR 34077). On September 6, 2011, we published a 12-month finding in the Federal Register (76 FR 55170), which determined that listing was warranted but precluded.

**Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:**

Hawaii

**Indicate which State(s) did not provide any information or comment:**

none

## **State Coordination:**

On February 20, 2013, we provided the Hawaii Division of Forestry and Wildlife (DOFAW) with copies of our most recent candidate assessments for their review and comment. New information was received on March 23, 2013, and incorporated into this report. We are in frequent contact with State biologists and believe this assessment contains the most recent available information on the species.

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Concur:

A handwritten signature in blue ink that reads "David Gotting". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

11/18/2014

Date

Did not concur:

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Date

Director's Remarks: